



## Case report

## Cardiac laceration without any external chest injury in an otherwise healthy myocardium – A case series



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## ABSTRACT

The heart is relatively well protected within the thoracic cavity from all the sides. Thus it is rather uncommon to find a cardiac laceration in cases of blunt trauma to the chest and that too when there is no evident injury to the chest wall. Several cases with history of death following blunt trauma were autopsied by us in recent months. Out of them, 3 cases that did not exhibit any external chest injury revealed hemopericardium following rupture of a cardiac chamber. The volume and suddenness of appearance of the hemopericardium were sufficient to cause tamponade. These case reports underline the importance of a systematic and complete autopsy in all cases of blunt trauma deaths even though they may be having no external injury. They also highlight that myocardial injury must be ruled out in every living patient presenting with blunt chest trauma even in the absence of an external sign.

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## 1. Introduction

Heart is vulnerable to both penetrating and non-penetrating blunt trauma. Blunt injuries of the heart are seen in civilian practice mainly in road traffic accidents, falls from height and in stamping assaults, though any heavy impact [including a punch] can cause fatal damage.<sup>1</sup>

The heart is relatively well protected within the thoracic cavity being located in the center of the chest with the lungs on either side and the sternum and the vertebral column protecting it from the anterior and posterior aspects respectively. Injury to the heart is usually associated with injury to other structures of the chest. It is not commonly realized that cardiac damage, especially contusion, due to non-penetrating trauma occurs frequently and missed since signs and symptoms due to electrical instability do not appear until 24–48 h after the injury.<sup>2</sup> Apart from contusion, laceration too has been found to occur in myocardium following blunt trauma to chest. Lacerations of the heart may occur in any of the chambers, but usually are found in the ventricles and almost invariably on the anterior surface or inferior

surfaces.<sup>3</sup> Moritz illustrates lacerations of the anterior surfaces of both ventricles and of the inter-ventricular septum.<sup>4</sup> Polson and Gee have found injuries equally frequent in the left and right ventricles.<sup>3</sup> Any traumatic rupture of heart has to be differentiated from spontaneous rupture. It must always be remembered that a healthy heart never ruptures spontaneously.<sup>5</sup> In traumatic ruptures, the heart is generally ruptured on right side and toward its base.<sup>6</sup> The ribs and skin overlying the structure are usually damaged. Rarely, it ruptures without any external mark of violence or causing fracture of ribs.<sup>6</sup> Even avulsion of the heart from its attachments could occur as a result of tractional force on the organs away from the neck.<sup>6</sup> While an unhealthy heart, especially the left ventricle, weakened by coronary disease or infarction, can rupture under increased blood pressure and sudden exertion,<sup>2</sup> injury and even arrhythmias can occur in a normal heart as a result of increase in intraventricular pressure caused by compression of the flexed legs over the abdomen. The heart may also get avulsed from its attachments as a result of tractional force on the organs away from the neck.<sup>6</sup>

We came across few cases within a short span of time [1 ½ months] wherein all the cases being that of road traffic accident, did not have any external chest injury yet revealed cardiac lacerations on internal examination at autopsy. These cases are presented in

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the article to emphasize that while dealing with blunt trauma cases, cardiac injury should be kept in mind by the clinicians as it may be present without any external sign of injury and examination of cardiac region along with head and abdomen should be made a habit in cases of blunt trauma.

## 2. Case reports

### 2.1. Case 1

A 47 years old male driver of a car was brought dead to casualty department with history of collision with a truck. Post mortem examination was conducted on same day within 6 h of the incident. The deceased was heavily built. Externally, a lacerated wound was present over the forehead with small graze abrasions on face. There was fracture of shaft of both femora at junction of middle and lower thirds. There was no external injury over chest.

Internally, there were fractures of right 3rd to 5th ribs in mid-clavicular line, fracture of left 2nd to 5th ribs in mid-clavicular line and left 4th–5th ribs in anterior axillary line. There was no retrosternal extravasation of blood. The pericardium was intact and pericardial cavity contained 130 cc of fluid and clotted blood. Heart revealed an oblique tear of  $3 \times 1$  cm size and extending into the ventricular cavity over anterior wall of right ventricle by the side of inter-ventricular septum near pulmonary outlet. There was an associated contusion of  $3 \times 2$  cm size over anterior wall of right atrium (Fig. 1). Weight of the heart was 426 g; valves, endocardium and myocardium were grossly normal; all three major coronaries were patent. Abdomen contained minimal blood from multiple superficial tears over superior surface of right and left lobe of liver.

Histopathological sections from margin of tear showed viable myocytes and few congested blood vessels with no evidence of ischemic changes or evidence of thinned out myocardium as a result of old healed myocardial infarction (Fig. 2).

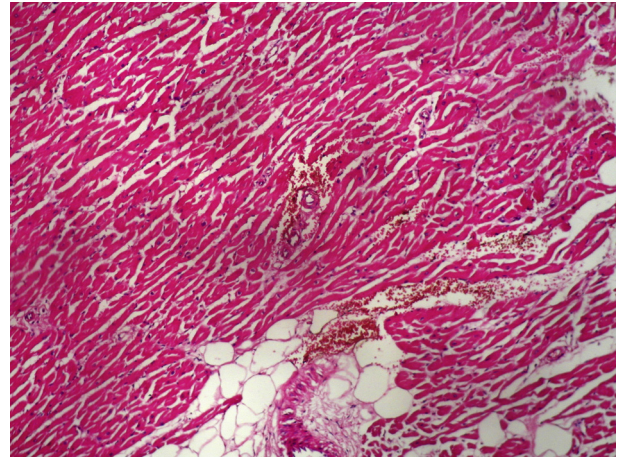
### 2.2. Case 2

A 3 years old male child was brought to casualty department with history of overturning of a cart on which he was sitting and expired within 25 min of his arrival. The post mortem was conducted after 12 h of the incident. The body was of average build and bore no marks of any external injury.

Internally, there was no injury in the chest wall. The pericardium was intact and pericardial cavity contained 100 cc of blood. Right atrium revealed a tear of size  $0.7 \text{ cm} \times 0.3 \text{ cm} \times$  cavity deep over anterior wall along the right border of heart (Fig. 3). There were



**Fig. 1.** Tear over anterior wall of right ventricle by the side of inter-ventricular septum near pulmonary outlet.



**Fig. 2.** Histopathological section from margin of tear in Fig. 1 showing viable myocytes and few congested blood vessels with no evidence of ischemic changes or evidence of thinned out myocardium.

multiple contusions on the anterior wall of the right atrium and anterior wall of ascending aorta measuring 0.2–0.5 cm length and 0.1–0.5 cm in width, all red in color. Weight of the heart was 33 g; valves, endocardium and myocardium were grossly normal; all three major coronaries were patent. Apart from cardiac injury, there was a thin layer of sub-arachnoid hemorrhage present diffusely all over the brain surface with ventricles containing blood-mixed CSF.

Histopathology examination of the site of tear was not done in this case as the victim was a child with no significant past medical history that could have led to thinning of myocardium. Gross examination of the tear site didn't reveal anything suspicious too.

### 2.3. Case 3

A 42 years old male was brought to casualty department with history of collision of auto rickshaw with a bus while he was traveling by an auto [passenger] and expired after 45 min of his arrival. The post mortem was conducted within 12 h of the incident. He was averagely built and had a lacerated wound over right ear lobule and left ala of nose with fracture shaft of radius and ulna on right side. There was no external injury over chest region.

Internally, there were fractures of right 2nd to 4th rib in anterior axillary line and left 4th and 5th rib in mid-clavicular line. The pericardium was intact and pericardial cavity contained 70 cc of blood. There was a tear of size  $2 \times 0.5 \times 0.5$  cm over posterior wall



**Fig. 3.** Tear over anterior wall of right atrium along the right border of heart.



of left ventricle near inter-ventricular septum. There was also a contusion of size  $4 \times 2$  cm over posterior wall of right atrium (Fig. 4). Weight of the heart was 238 g; valves, endocardium and myocardium were grossly normal; all three major coronaries were patent. Apart from cardiac injury, there was also a tear of  $3 \times 0.5 \times 0.5$  cm over diaphragmatic surface of right lobe of liver and  $1 \times 0.5 \times 0.3$  cm over hilar surface of spleen near lower pole.

Histopathology examination of the site of tear was not done in this case as the victim was neither the driver of either of the involved vehicles, nor did he have any significant past medical history to suspect previous thinning of myocardium from infarction. The tear site was grossly unremarkable.

### 3. Discussion

Over the past 2–3 decades, non-penetrating chest trauma with injury to heart and aorta has become increasingly common, particularly as a result of rapid deceleration in high speed vehicular accidents.<sup>7</sup>

Literature was searched for similar cases being reported. Modi has reported few cases of cardiac rupture where in one case an old woman who was run over by a cart suffered an irregular rupture of the right ventricle of the heart without any fracture of the ribs, or external injury on the left side of the chest. The second, third and fourth ribs were, however, fractured on the right side. In second case, the autopsy of a one-and-a-half year old child, who was run over by a horse-drawn cart and died immediately, revealed a contusion of the pericardium and the right chamber of the heart and laceration of both lungs, but no external injury on the chest or fracture of ribs.<sup>6</sup>

Cardiac rupture after blunt trauma is usually fatal. The severity and extent of damage depends upon the phase of the cardiac cycle at the time of injury. Late diastole or early systoles are periods of increased vulnerability because the chambers are full and the valves are closed.<sup>8</sup> The mechanism is probably due to rapid compression of the heart during these periods which can result in rupture of one or more chambers, laceration or perforation of ventricular septum or injury to mitral or aortic valve. As the pressure within the ventricles is higher than that in the atria, exsanguination is more rapid with resultant cardiac tamponade and death. For the same reason, patients with an atrial injury usually survive long enough to reach the hospital.<sup>8</sup>

Blunt chest trauma can induce myocardial lesions by several mechanisms, including direct transfer of kinetic energy during the impact on the chest, a sudden forceful deceleration process of the heart, and compression of heart between the sternum and the

spine.<sup>9</sup> Impact may produce distension, shearing, or rupture of the heart according to the “water hammer effect”.<sup>10,11</sup>

Not only laceration of heart, blunt trauma can also cause pericardial rupture and luxation of the heart. In rare cases, initial diagnosis may be missed, the patient may even survive and the rupture gets re-organized.<sup>12</sup>

The presented cases too demonstrate similar picture wherein for the last 2 cases, who were hospitalized for at least  $\frac{1}{2}$ –1 h, were never investigated for any cardiac injury. This may be especially because there was no external injury to provide any suspicion. Occult cardiac injury after blunt chest trauma is probably more common than generally suspected in living patients. Indeed, the clinical presentations of such injuries are extremely variable and are frequently unnoticed in the multi-traumatized patient.<sup>13</sup> Therefore, such cases provide an indication that while dealing with blunt trauma cases, routinely, investigations for chest injuries, especially cardiac injury, should also be done along with evaluation for head and abdominal injuries.

### 4. Conclusion

The high mortality rate of cardiac injuries and possible late diagnosis make blunt cardiac injuries an important challenge in treatment of injured. Blunt traumatic cardiac rupture is a relatively uncommon diagnosis and is usually associated with high mortality rate. A high index of suspicion about possibility of cardiac rupture is required during management of a case of polytrauma where significant cardiac findings get masked by the presence of other injuries or features of shock due to cardiac tamponade as a result of cardiac rupture are misinterpreted as those due to internal (usually abdominal) visceral bleed and investigated as such.

#### Conflict of interest

None declared.

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#### Ethical approval

None declared.

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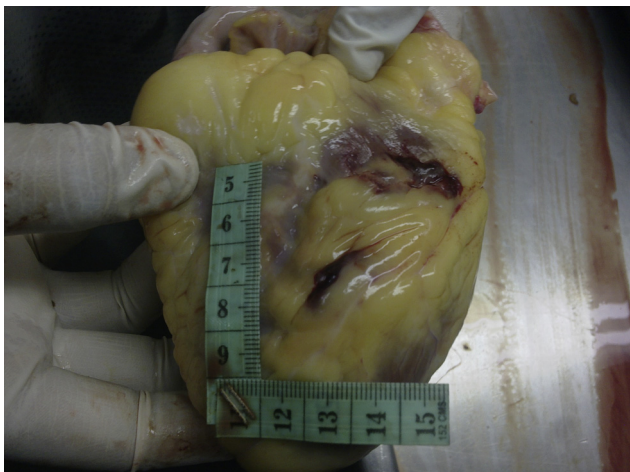


Fig. 4. Tear over posterior wall of left ventricle near inter-ventricular septum.